

Interactive Augmented Reality (IAR)-Based Student Worksheets (LKPD): A Solution & Variation of Abstract Learning Media to Concrete in Middle School

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Submission : 04/02/2025

Revision : 21/04/2025

Accepted : 12/08/2025

ABSTRACT

This study aimed to develop a Student Worksheet (LKPD) on the human digestive system material integrated with Interactive Augmented Reality (IAR) using Android and to evaluate its feasibility based on expert, teacher, and student assessments. The research employed a Research and Development (R&D) approach with the 4D model consisting of Define, Design, Develop, and Disseminate stages. Data were collected through validation questionnaires from material and media experts and assessment questionnaires from science teachers and students. The trial subjects were Grade VIII students at SMP Muhammadiyah Kuala Tungkal. Material expert validation was carried out in three stages, resulting in a 100% score, categorized as "Very Feasible." Media expert validation, conducted in two phases, obtained a score of 95%, also categorized as "Very Feasible." Science teacher assessment yielded 85% ("Very Eligible"), while student assessments showed 81% in the small group trial and 84% in the large group trial, both categorized as "Very Eligible". The findings indicate that the developed LKPD, supported by Interactive Augmented Reality technology on Android, meets the feasibility standards for use as a learning medium and teaching material for Grade VIII junior high school students in the human digestive system topic. This integration of IAR is expected to enhance learning interactivity, student engagement, and conceptual understanding in science education.

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Keywords: Student worksheet, Digestive system, Four-D, Interactive augmented reality

Introduction

Learning media is a way to make learning more enjoyable and help students better understand abstract material ([Bafadal, 2005](#)). Learning media is a means between teachers and students, so that they are connected, provide information, and deliver messages to create effective and efficient learning processes ([Santayasa, 2009](#)). Therefore, it is important to provide teaching materials such as LKPD (Student Worksheets), which have an important role in providing concise material, and tasks that students can do independently ([Prastowo, 2013](#)). Technology has the potential to be a medium that can help educators in the learning process in the field of education, as one of the electronic media. Technology has formed a new view in the learning and teaching process and the management of educational organizations. The form of innovation teachers can carry out by utilizing digital technology is then applied through new methods and strategies in learning ([Rezaldi & Mangkurat, 2022](#)), one of which is by implementing Android-based Augmented Reality.

The use of Augmented Reality (AR) technology in education has a positive impact, including being able to increase the achievement of learning material content, motivating students to learn material content, opening up opportunities for students to seek scientific information, increasing student activity in learning, displaying content that is not observed by the naked eye as if it were real, and presenting information that can be readily accepted by students ([Yusma & Sulistiyawati, 2021](#)). Augmented Reality (AR) can create interesting and efficient learning ([Aditama, 2019](#)). Augmented Reality (AR) is a technology that concretises 2-dimensional or 3-dimensional objects as if they were in the real world ([Atmaja, 2018](#)).

Based on the defined stage of the results of observation and interviews at SMP Muhammadiyah Kuala Tungkal, it was found that the curriculum used in the school is the independent curriculum (grade VII) and still uses the 2013 curriculum (grades VIII and IX). Science learning at school uses learning media like PowerPoint, learning videos and pictures. This school also uses teaching materials in the form of printed books from the independent curriculum and the 2013 curriculum, and LKPD (Student Worksheets). The use of LKPD in this school is beneficial for teachers in the learning process, especially in giving independent assignments to students. However, the LKPD has shortcomings, such as not having audio and video. So that the material cannot be presented clearly visually. Therefore, efforts are needed to improve the quality of LKPD, including supporting media, to facilitate more interactive and practical learning for students. LKPD can increase students' interest and interest in learning, can be used in independent learning, can be used anywhere and anytime because it can be accessed through devices close to students ([Dwi 2023](#)). [Muslimah \(2020\)](#) stated that LKPD is a facility that is applied at the learning stage to facilitate and facilitate efficient communication between students and educators, so that it can foster student activities to improve problem-solving skills.

Based on the definition stage in the results of the questionnaire distribution in class VIII of SMP Muhammadiyah Kuala Tungkal, as many as 53.3% students faced difficulties in understanding science material, especially in the human digestive system material, because the material was quite abstract and difficult to understand. As many as 73.3%) students said that teachers used technology-based learning methods such as e-LKPD or learning videos. As many as 66.7%) students said that LKPD equipped with pictures and videos would significantly influence their understanding of the material. In line with this, ([Barlenti, et.al. 2017](#)) said that LKPD supports the learning process that is made interesting and systematic so that it can help students be active in learning both independently and in groups. According to ([Fauziyah et al., 2024](#)) Using visual and interactive media can make students more actively involved in the learning process and have control over their learning experiences.

Based on the problems described, it is necessary to develop interactive learning media to support students in learning to be more active and efficient. The use of Interactive

Augmented Reality-based LKPD in education to improve the quality of learning and students' understanding of the learning materials provided by teachers. Therefore, the solution obtained is to develop an Augmented Reality-based LKPD to support the human digestive system material, which students consider difficult. One innovation in the form of learning media can improve students' understanding completely and can be applied in everyday life easily ([Risdiyanti & Sulisworo, 2021](#)). Augmented Reality (AR) also supports understanding complex phenomena by providing unique visual and interactive experiences, combining information and virtual, presenting abstract problems to students ([Haller, et.al., 2007](#)).

The purpose of this study was based on the background described previously, namely, to produce, determine the feasibility, and assess the students' and teachers' opinions on LKPD based on Augmented Reality on the digestive system material for junior high schools.

Methods

This research is a R&D (Research and Development) development research using the 4D research model with stages (Define, Design, Develop and Disseminate). The 4D model is used to produce specific products and test the effectiveness of the product ([Sugiyono, 2010](#)). This Development Model was developed by [Thiagarajan \(1974\)](#). The 4D model is a model that is arranged in a programmed manner with systematic activity steps in solving learning problems with learning resources related to student needs ([Arywiantari et. al., 2015](#)).

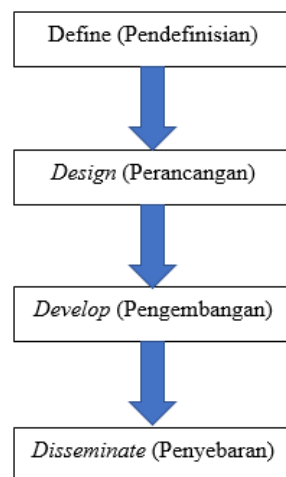


Figure 1. 4D Model development stages
(Maydiantoro, 2021)

Creating an Interactive Augmented Reality-based LKPD begins with defining the problems and needs of students. At the define stage, researchers conduct student needs analysis and curriculum analysis. At the design stage, this LKPD is designed with the Canva application in the form of handouts, and its application uses the Assembler Edu application on Android. Expert validation is carried out on the developed product at the development stage, and a material and media expert carries out the validation. After the validation stage, the product is tested at school, namely a trial on science teachers and class VIII students of SMP Muhammadiyah Kuala Tungkal. This is done to see the practicality and effectiveness of the product being developed. The last stage is dissemination, which is carried out by disseminating the product that has been developed.

Results and Discussion

This research produced media and teaching materials in the form of Interactive Augmented Reality (IAR)-based Student Worksheets (LKPD) using Android for the human digestive system material for junior high school students. This research used the 4D (Four-D) model

consisting of four stages: Define, Design, Develop, and Disseminate. The following are the stages in the 4D development described as follows:

Define

The results of the definition showed that students experienced difficulties in understanding the material on the human digestive system, with a percentage of 53.3%. The problems encountered were caused by the learning material being abstract and difficult to understand, and a lack of focus and attention from students. Therefore, learning media are needed to increase student enthusiasm, and interactive media can be used independently. Based on this, interactive media that students can use independently is the use of LKPD media based on Interactive Augmented Reality (IAR). According to Wahyuningtyas & Sulasmono (2020) Using teaching media in the teaching and learning process can arouse new desires and interests and motivate students in the learning process.

Design

The developed product was designed with the initial step of creating a Storyboard. Then the LKPD was designed by entering the material using the Canva application. Next, creating 3D images based on Interactive Augmented Reality was developed using the Android-based Assembr Edu application, which would later produce a QR code. The contents of this Interactive Augmented Reality-based LKPD include a foreword, instructions for use, concept maps, table of contents, description of the material on the human digestive system, description of the material on disorders of the human digestive system, student worksheets (discussion and independent), and developer profiles.

Develop

The designed product then undergoes the development stage. It will undergo a feasibility test, which includes validation by material and media experts. The product validation results can be seen in the table below.

The developed LKPD is based on interactive Augmented Reality (IAR), namely by presenting interactive and engaging materials, as 3D images, which makes it easier for students to understand the material. This interactive Augmented Reality (IAR)-based LKPD solves students' problems with difficulty understanding the material, especially the human digestive system material. This is because using an Interactive Augmented Reality (IAR)-based LKPD developed by researchers can increase students' interest and enthusiasm in following the learning process.

The development of an Interactive Augmented Reality (IAR)-based LKPD on the human digestive system material begins with creating a storyboard that is used as a reference in creating designs on the Canva application. Furthermore, creating 3D images based on Interactive Augmented Reality (IAR) is designed using the Android-based Assembr Edu application, which will later produce a QR code.

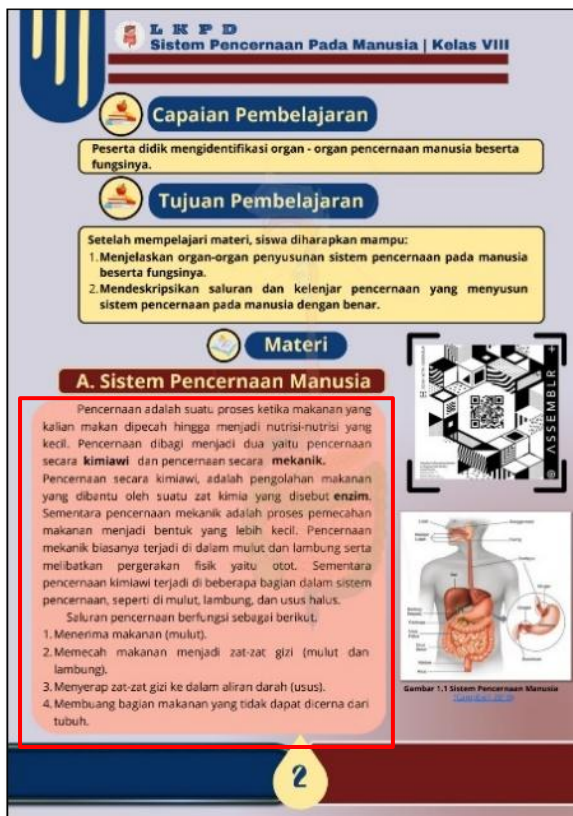
Table 1. Results of validation by material experts on LKPD development

No	Assessment Aspects	Validation Stage - (%)		
		1	2	3
1	Content/Material Suitability	63,8%	88,8%	100%
2	Language	75%	100%	100%
3	Evaluation	75%	100%	100%
Average		70%	95%	100%

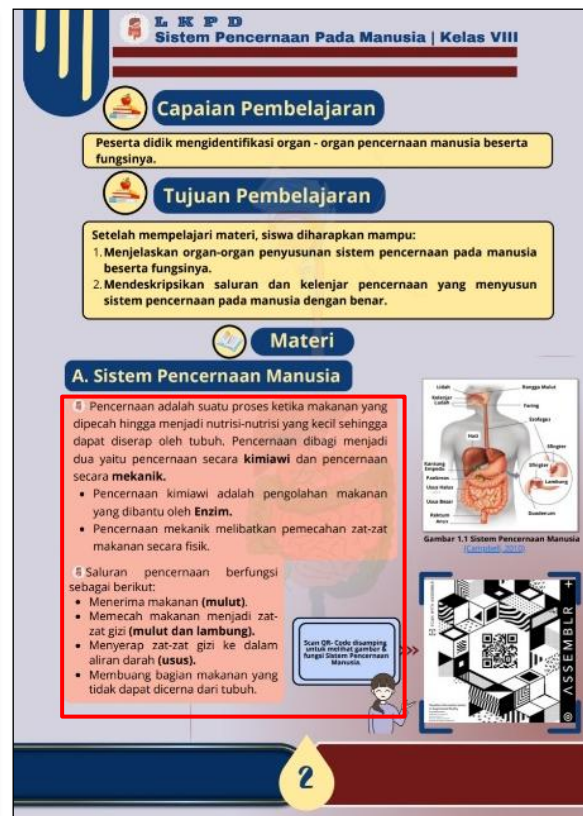
Category	(Useable with revision)	(Very Worth using with revision)	(Very Suitable for use without revision)
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Based on Table 1, the validation results by material experts show that in stage I, the product developed is still not feasible to be tested in the field, with a percentage of 70% in the category "Feasible". Therefore, the material validator provides suggestions and input on the product being developed to improve the product. After that, material validation was carried out again in stage II, with a percentage of 95% in the category "Very feasible" with revisions according to the suggestions and input from the validator. Furthermore, stage III material validation was carried out again with a percentage of 100% in the category "Very Feasible", so it can be concluded that the product developed can be tested from a material aspect without any revisions.

This media is designed to be attractive in terms of appearance, color, and content, so that it can make students more interested and enthusiastic about following the learning process (Agustir & Rahmi, 2020). Learning media plays an important role in students' interest in learning by facilitating interesting learning, making it easier for students to understand what they have seen.



(a) Before Revision



(a) After Revision

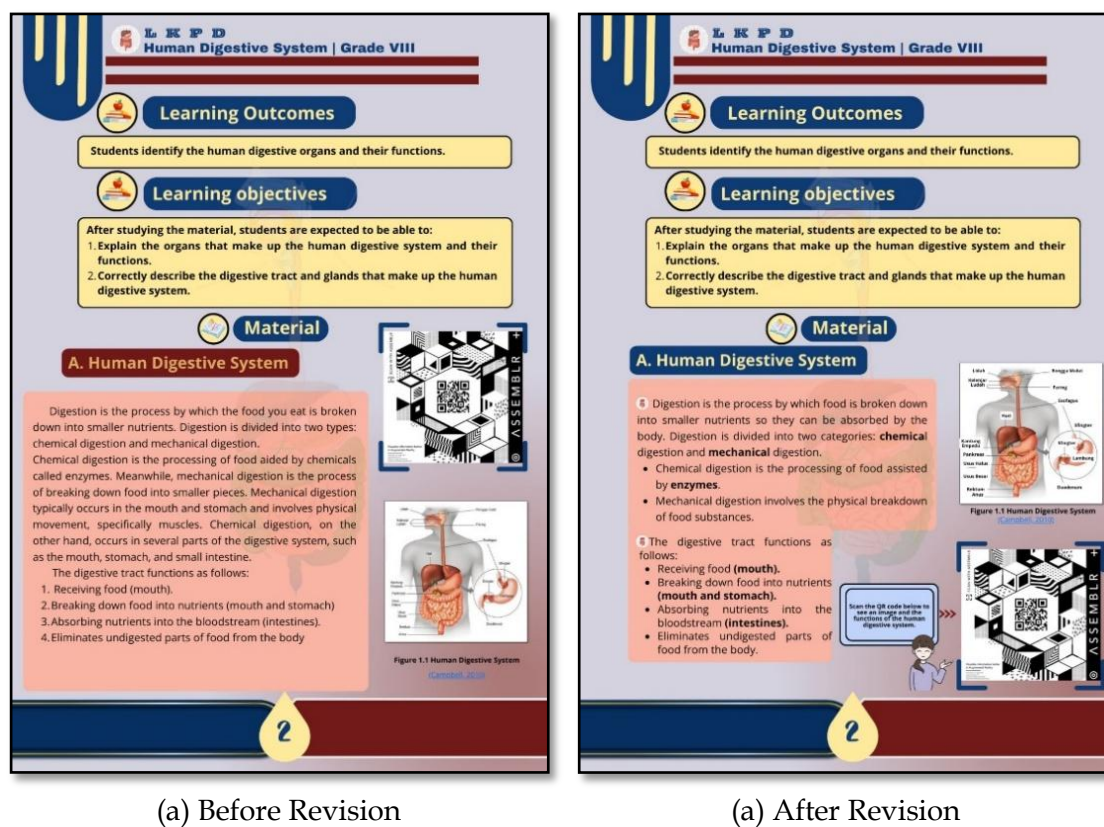


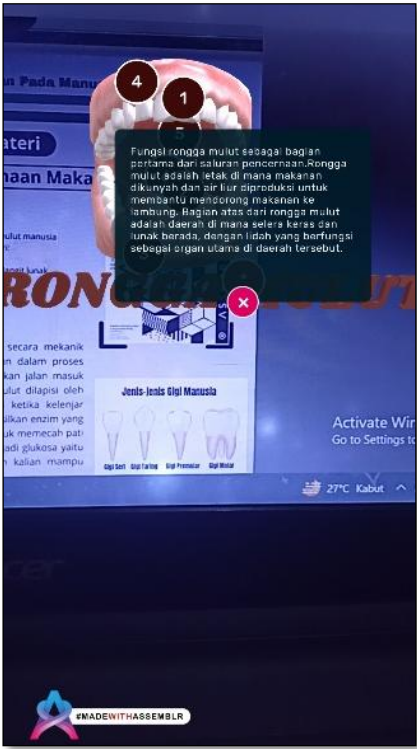
Figure 1. Learning media design

Table 2. Media expert validation results for LKPD development

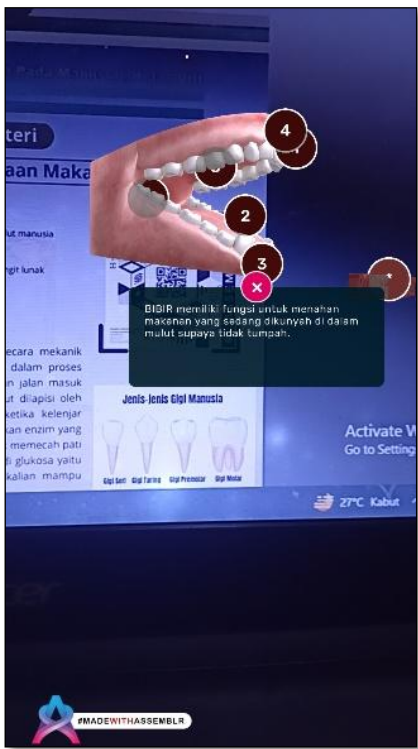
No	Assessment Aspects	Validation Stage - (%)	
		1	2
1	Operation	66,6%	95,8%
2	Media Presentation	52%	95,8%
3	Technical design	62,5%	87,5%
	Average	57,5%	95%
	Category	(Not Worth Testing)	(Worthy of being tested in the field)

Based on Table 2. The results of media validation in stage 1 show that the developed product is still not feasible to be tested in the field, with a percentage of 57.5% in the category of "Not Feasible". Improvements need to be made to the product, media validation in stage II with a rate of 95% in the category of "Very Feasible", so it can be concluded that the developed product can be tested from the media aspect without any revision.

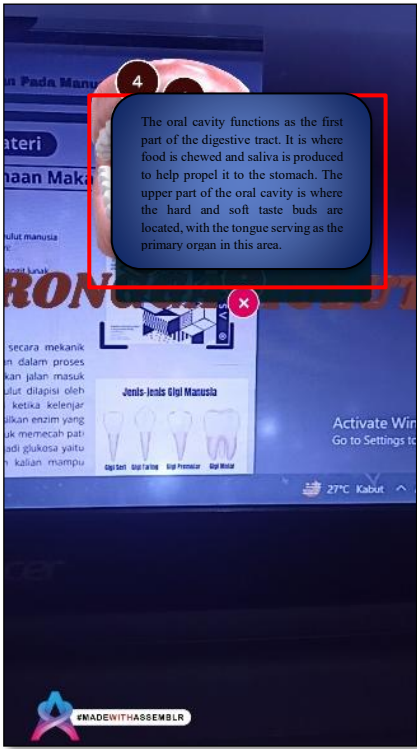
This success is also obtained from elements such as 3D images based on Augmented Reality (AR), audio, and video in LKPD based on Interactive Augmented Reality (IAR), which can attract the interest and enthusiasm of students in the learning process. According to [Mariyati et al. \(2022\)](#), the use of technology in learning media has a significant role in improving the quality of learning, motivating students, and helping in constructing student knowledge effectively and efficiently.



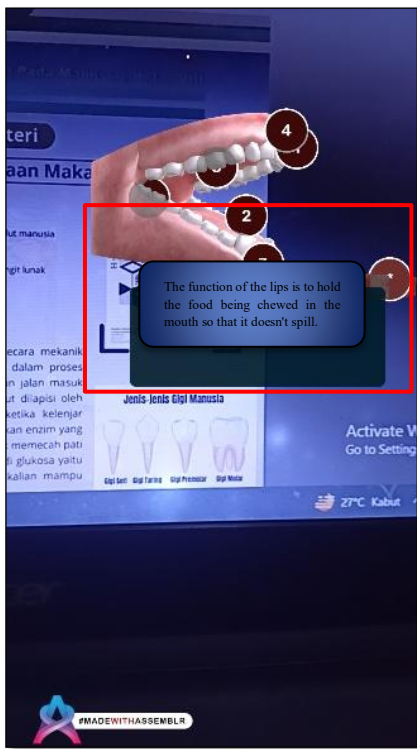
(a) Before Revision



(b) After Revision



(a) Before Revision



(b) After Revision

Figure 2. 3D images based on Augmented Reality (AR) in LKPD

Table 3. Results of the science subject teacher assessment on LKPD development		
No	Assessment Aspects	Validation Stage - (%)

1	Content Eligibility	85%
2	Language Eligibility	85%
3	General View (Visualization)	87,5%
4	Instructions for use	87,5%
5	Clarity of Question Description	75%
Average Category		85%⁰⁰ Very Worth It

Based on Table 3. The assessment results of the science subject teacher of class VIII of SMP Muhammadiyah Kuala Tungkal, on the learning media, with a percentage score of 85% in the category "Very Eligible". The results of this assessment indicate that the Interactive Augmented Reality (IAR)-based LKPD, based on Android, which was developed, is feasible to be tested in the learning process. According to [Farizka et al. \(2021\)](#), the learning media teachers can use to hone and improve students' understanding of learning materials is LKPD (Student Worksheets). In LKPD, there are working methods, material summaries, and worksheets.

Table 4. Results of student assessment of LKPD development

No	Assessment Aspects	Small Group Test	Large Group Test
1	Convenience	78,9%	83,4%
2	Interest	81,5%	84,6%
3	The sequence	83,5%	83%
4	Language	78,1%	83,9%
Average Category		81% Very Worth It	84% Very Worth It

Based on Table 4, The results of the Student Assessment in the small group trial obtained a percentage of 81% with the category "Very Appropriate", while in the large group trial, 84% with the category "Very Appropriate". These results indicate that the Interactive Augmented Reality (IAR)-based LKPD using Android has met the needs of students and can be used as media and teaching materials in the learning process. [Agustira & Rahmi \(2020\)](#) stated that learning media plays a vital role in students' interest in learning by facilitating enjoyable learning so that it is easier for students to understand what they have seen. [Simanjuntak & Simanjuntak \(2020\)](#) stated that the presence of interactive media in learning will make it easier for students to achieve an effective learning process.

Using an Interactive Augmented Reality (IAR) based LKPD on human digestive system material in the learning process can help students have an easier and deeper understanding of the material. This LKPD is a solution and variation of abstract learning media to become concrete. According to [Wahyuningtyas & Sulasmono \(2020\)](#), using teaching media in the teaching and learning process can arouse new desires and interests, motivating students in the learning process. This Interactive Augmented Reality (IAR) based LKPD can be a media and teaching material that can increase students' interest and enthusiasm in participating in the learning process.

Furthermore, the researcher collected data on learning ability results by giving an initial test (pretest) and a final test (posttest) consisting of 10 multiple-choice questions to measure the effectiveness of the media developed. The aim is to determine whether the Interactive Augmented Reality (IAR)-based LKPD developed can be a solution and variation to the learning process.

Table 5. Pretest and posttest data

Number of Students	Average Pretest Score	Average Posttest Score
22 people	47,2%	84%
Category	Low	Tall

Disseminate

At this stage, the product that has been developed and has gone through several stages so that it has met the category of "Very feasible" can be disseminated. This study disseminated LKPD products based on Interactive Augmented Reality (IAR) on the human digestive system material in class VIII of SMP Muhammadiyah Kuala Tungkal.

Conclusion

Based on the results of the study and discussion, it can be concluded that the Interactive Augmented Reality (IAR)-based LKPD using Android on the human digestive system material developed with the 4D (Four-D) model, Validation of material experts on LKPD is 100% with the category "Very Eligible". Validation of media experts on LKPD is 95% with the category "Very Eligible". The assessment of science subject teachers on LKPD is 85% with the category "Very Eligible". Student assessment of LKPD is 83.9% with the category "Very Eligible". This study produces an interactive augmented reality (IAR)-based LKPD product that is feasible to use as a media and teaching material for the subject of the human digestive system in grade VIII junior high school.

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